We Claim:

1. A microfluidic sieve comprising:

   a substrate having a microfluidic channel; and

   a carbon nanotube mesh comprising a plurality of intertwined free-standing carbon nanotubes fixedly attached within said channel for separating, concentrating, and/or filtering molecules flowed therethrough.

2. The microfluidic sieve of claim 1,

   wherein said carbon nanotubes extend randomly from the surface of said channel characteristic of free-growth structures.

3. The microfluidic sieve of claim 1

   wherein at least a segment of said channel is filled with said carbon nanotube mesh.

4. The microfluidic sieve of claim 1

   wherein at least a segment of said channel is surface-coated with said carbon nanotube mesh without filling the segment, so as to define a gap therethrough.

5. The microfluidic sieve of claim 1,

further comprising at least one more of said carbon nanotube mesh, wherein said carbon nanotube meshs are fixedly attached to corresponding segments of said channel.

6. The microfluidic sieve of claim 5,

   wherein at least one of said channel segments is filled with a corresponding one of said carbon nanotube meshs.

7. The microfluidic sieve of claim 5,

   wherein at least one of said channel segments is surface-coated with a corresponding one of said carbon nanotube meshs without filling the channel segment, so as to define a gap therethrough.

8. The microfluidic sieve of claim 5,

   wherein said carbon nanotube meshs are configured to optimally separate, concentrate, and/or filter molecules when flowed therethrough in succession.

9. The microfluidic sieve of claim 1,

   wherein the surfaces of said carbon nanotubes are functionalized to chemically select/discriminate molecules.

10. The microfluidic sieve of claim 9,

wherein the surfaces of said carbon nanotubes are functionalized with a nanotube coating.

11. The microfluidic sieve of claim 10,

wherein the nanotube coating comprises a chemical derivatization.

12. The microfluidic sieve of claim 1,

wherein said carbon nanotube mesh has pore sizes of 10 to 200 nanometers.

13. The microfluidic sieve of claim 1,

wherein said substrate is a patternable material with said microfluidic channel etched as a groove thereon.

14. The microfluidic sieve of claim 13,

further comprising a cover layer bonded to said substrate to sealably cap the groove of said microfluidic channel.

15. The microfluidic sieve of claim 14,

wherein the cover layer is anodically bonded to said substrate.

16. The microfluidic sieve of claim 14,

wherein said bonded cover layer packs said carbon nanotube mesh into the groove of said microfluidic channel.

17. The microfluidic sieve of claim 1,

wherein said substrate has at least one more of said microfluidic channel and a corresponding carbon nanotube mesh fixedly attached therein.

18. The microfluidic sieve of claim 1,

further comprising at least one securing nubbin positioned in said channel to prevent the dislocation of said carbon nanotube mesh.

19. The microfluidic sieve of claim 18,

wherein said securing nubbin(s) is a microfabricated post adjacently positioned downstream of said carbon nanotube mesh.

20. A method of fabricating a microfluidic sieve, comprising:

providing a substrate having a microfluidic channel; and

growing a plurality of intertwined free-standing carbon nanotubes in said channel to produce a carbon nanotube mesh fixedly attached therein and capable of separating, concentrating, and/or filtering molecules flowed therethrough.

21. The method of claim 20,

wherein said carbon nanotubes are free-grown to extend randomly from the surface of said channel into the free space of said channel.

22. The method of claim 20,

wherein said carbon nanotubes are grown to fill at least a segment of said channel.

23. The method of claim 20,

wherein said carbon nanotubes are grown to surface-coat at least a segment of said channel without filling the segment, so as to define a gap therethrough.

24. The method of claim 20,

further comprising growing at least one more of said carbon nanotube mesh, wherein said carbon nanotube meshs are fixedly attached to corresponding segments of said channel.

25. The method of claim 24,

wherein at least one of said carbon nanotube meshs is grown to fill a corresponding one of said channel segments

26. The method of claim 24,

wherein at least one of said carbon nanotube meshs is grown to surface-coat a corresponding one of said channel segments without filling the channel segment, so as to define a gap therethrough.

27. The method of claim 24,

further comprising configuring said carbon nanotube meshs to optimally separate, concentrate, and/or filter molecules when flowed therethrough in succession.

28. The method of claim 20,

further comprising functionalizing the surfaces of said carbon nanotubes to select/discriminate molecules.

29. The method of claim 28,

wherein the surfaces of said carbon nanotubes are functionalized by applying a nanotube coating having the desired functionality.

30. The method of claim 29,

wherein the nanotube coating comprises a chemical derivatization.

31. The method of claim 20,

wherein said carbon nanotube mesh has pore sizes of 10 to 200 nanometers.

32. The method of claim 20,

wherein the microfluidic channel is formed on said substrate by etching a groove thereon.

33. The method of claim 32,

further comprising bonding a cover layer to said substrate to sealably cap the groove of said microfluidic channel.

34. The method of claim 33,

wherein the cover layer is anodically bonded to said substrate.

35. The method of claim 33,

wherein bonding the cover layer to said substrate packs said carbon nanotube mesh into the groove of said microfluidic channel.

36. The method of claim 20,

further comprising depositing a CVD growth catalyst in said microfluidic channel and utilizing a CVD growth process to grow said carbon nanotube mesh.

37. The method of claim 36,

wherein the CVD growth process includes pyrolysis of a mixture of ethylene, hydrogen, and argon at 850 degrees Celsius.

38. The method of claim 37,

wherein the CVD growth catalyst is iron.

39. The method of claim 38,

wherein the iron catalyst is deposited as a thin film.

40. The method of claim 39,

wherein the thin film iron catalyst has a thickness of about 5 nanometers.

41. The method of claim 20,

wherein said substrate has at least one more of said microfluidic channel and a corresponding carbon nanotube mesh fixedly attached therein.

42. The method of claim 20,

further comprising positioning at least one securing nubbin in said channel to prevent the dislocation of said carbon nanotube mesh.

43. The method of claim 42,

wherein said securing nubbin(s) is a microfabricated post adjacently positioned downstream of said carbon nanotube mesh.

44. A microfluidic sieve produced according to the method of claim 20.

45. A method of separating, concentrating, and/or filtering molecules comprising:

flowing molecules through a microfluidic channel having a carbon nanotube mesh comprising a plurality of intertwined free-standing carbon nanotubes fixedly attached within said channel, whereby said carbon nanotube mesh operates as an active medium for separating, concentrating, and/or filtering said molecules.

46. The method of claim 45,

wherein the flow through the microfluidic channel is a pressure driven flow.